

Progress Under Duress: NIDIS Drought Early Warning in the Upper Colorado River Basin

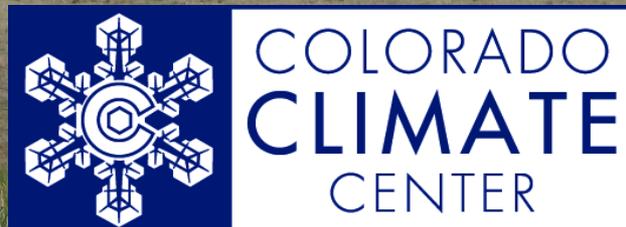
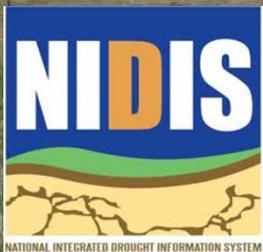
Nolan Doesken, Rebecca Smith, Wendy Ryan, Morgan Phillips, Jim Verdin (USGS), Taryn Finnessy (CWCB) and others

Colorado Climate Center

Department of Atmospheric Science

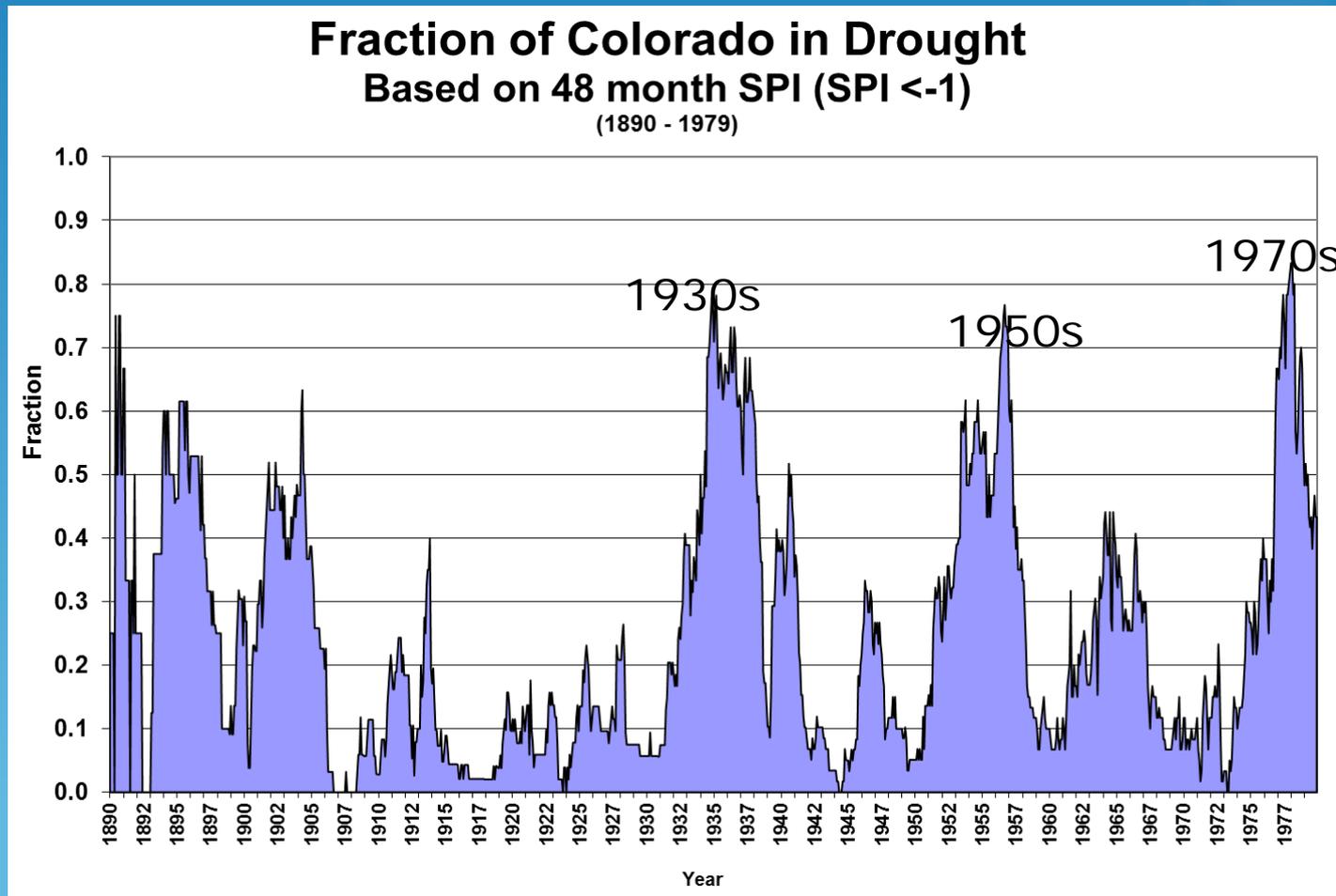
Colorado State University

Fort Collins, Colorado

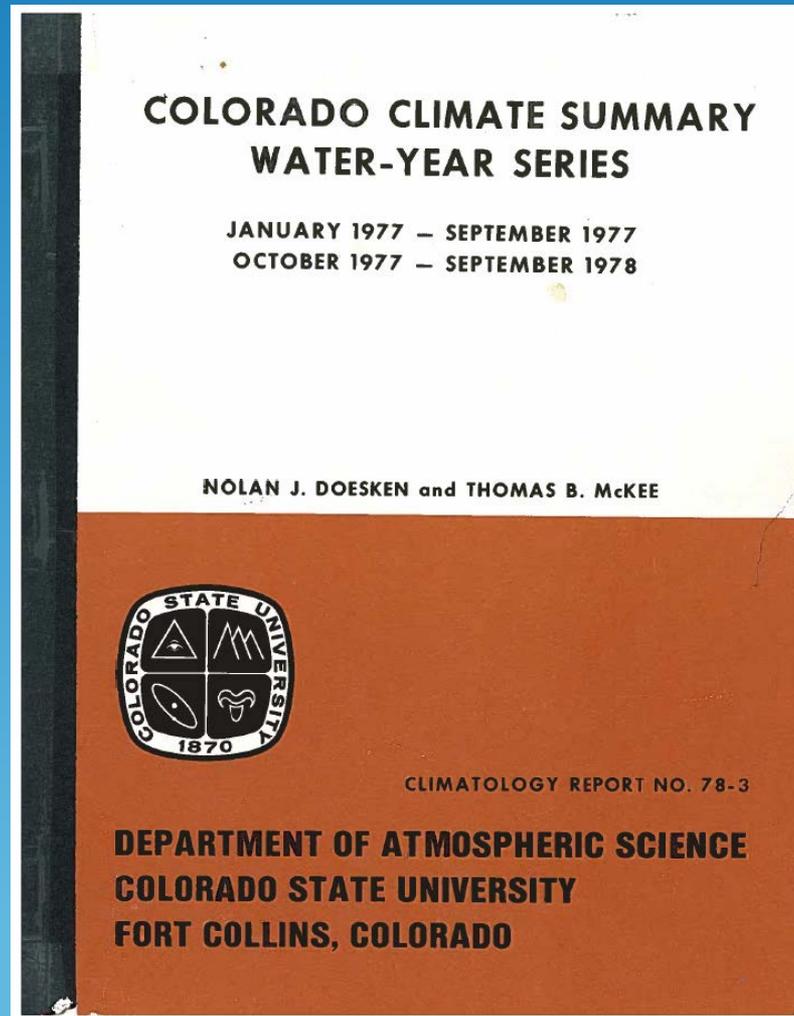


Brief Background --

The Colorado Climate Center was established in 1974 and soon faced another major Colorado drought episode

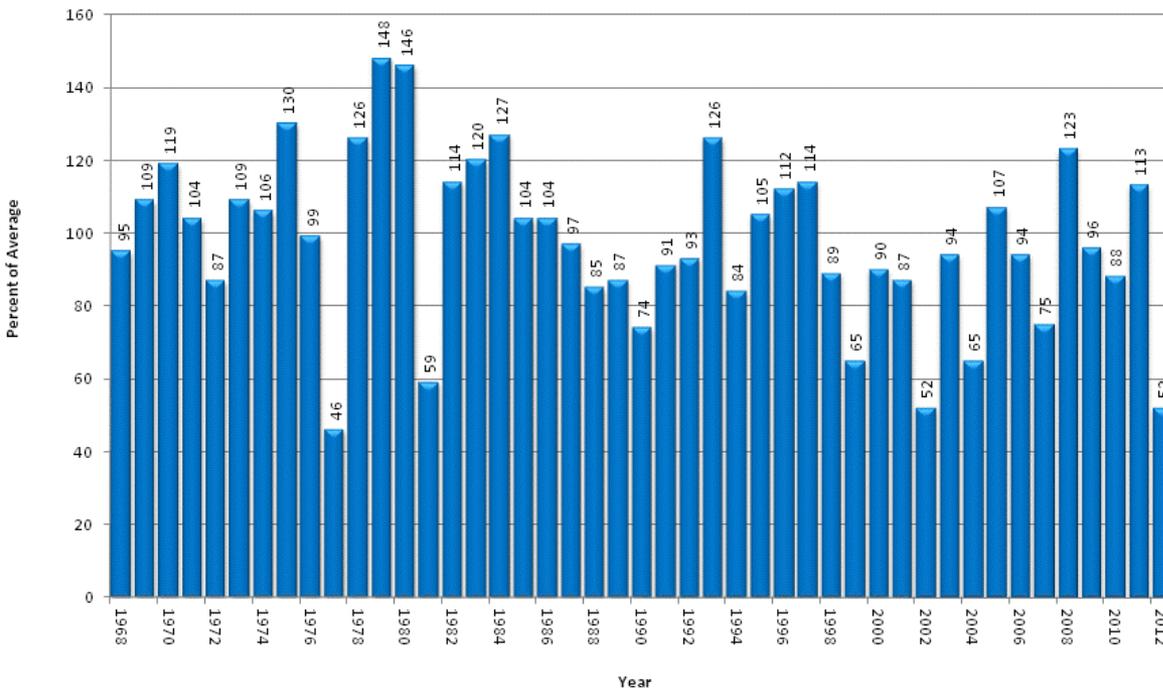


The severe drought of 1976 -77 motivated the beginning of monthly climate assessment reports.



Two winter droughts in quick succession (1977 and 1981) under the same governor (Richard Lamm) – both having considerable impact on our huge recreation industry – stimulated the creation of our first Colorado Drought Response plan (1981).

April 1 Colorado State-Wide Snowpack



THE
COLORADO
DROUGHT
RESPONSE
PLAN



RICHARD D. LAMM
GOVERNOR
May 15, 1981

Systematic coordinated drought monitoring has been continuous ever since under the auspices of the Colorado Water Availability Task Force (WATF)

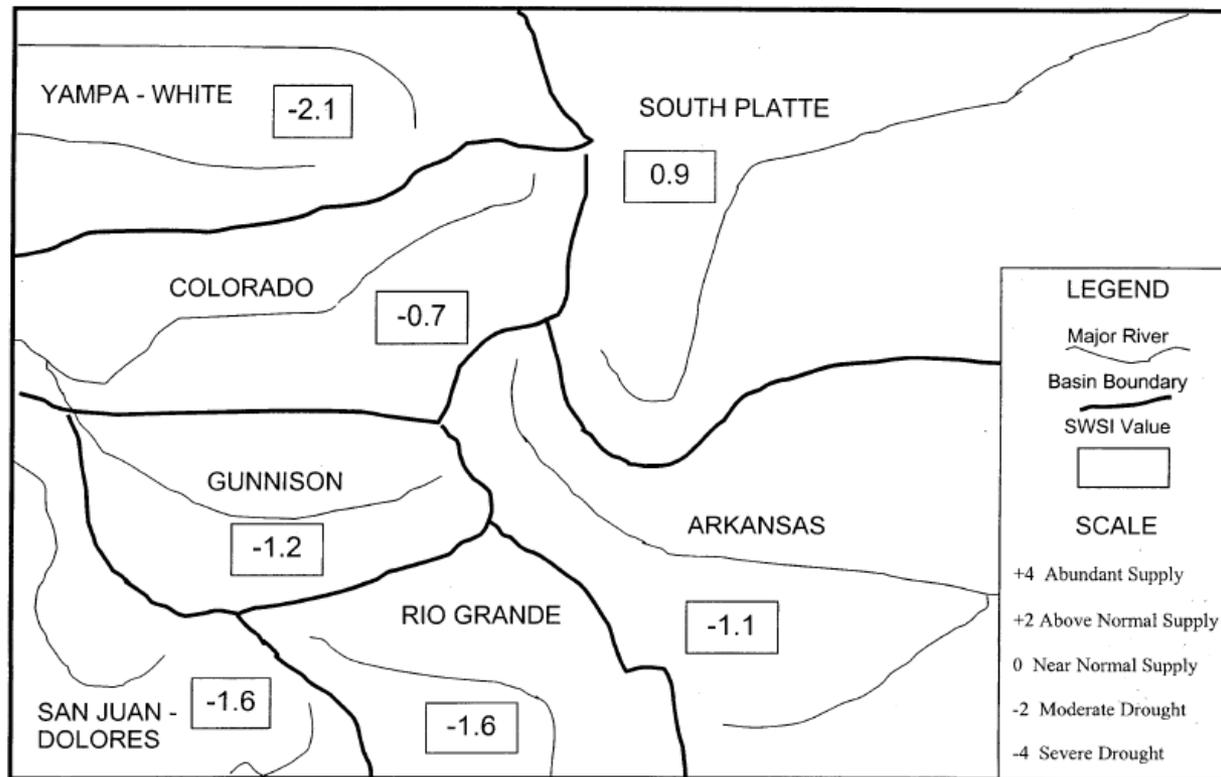


Throughout the past 3 decades we've
seen steady improvement in drought
monitoring



Development of Surface Water Supply Index for Colorado

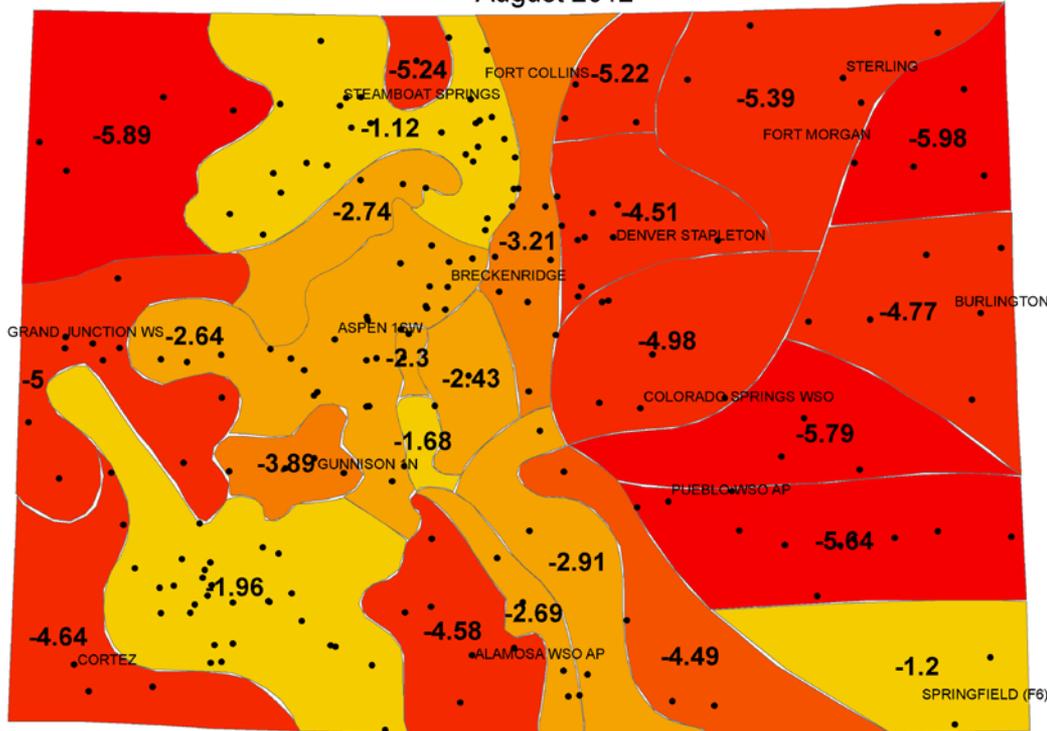
SURFACE WATER SUPPLY INDEX FOR COLORADO



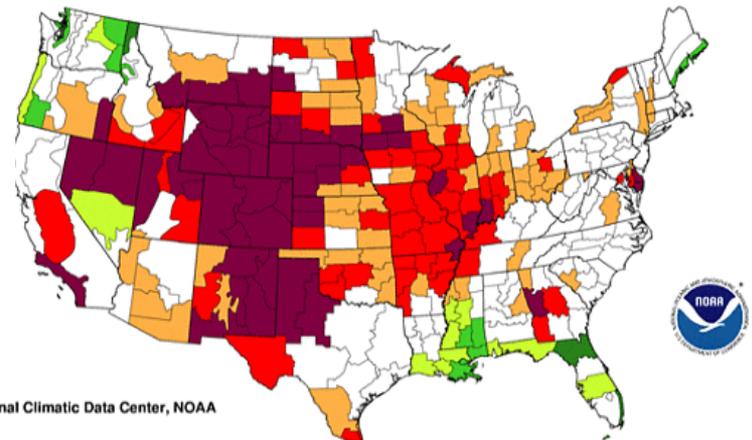
APRIL 1, 1999

Customization of the Palmer Drought Severity Index for Colorado

Modified Palmer Drought Severity Index for Colorado
August 2012



Palmer Drought Index
Long-Term (Meteorological) Conditions
August 2012



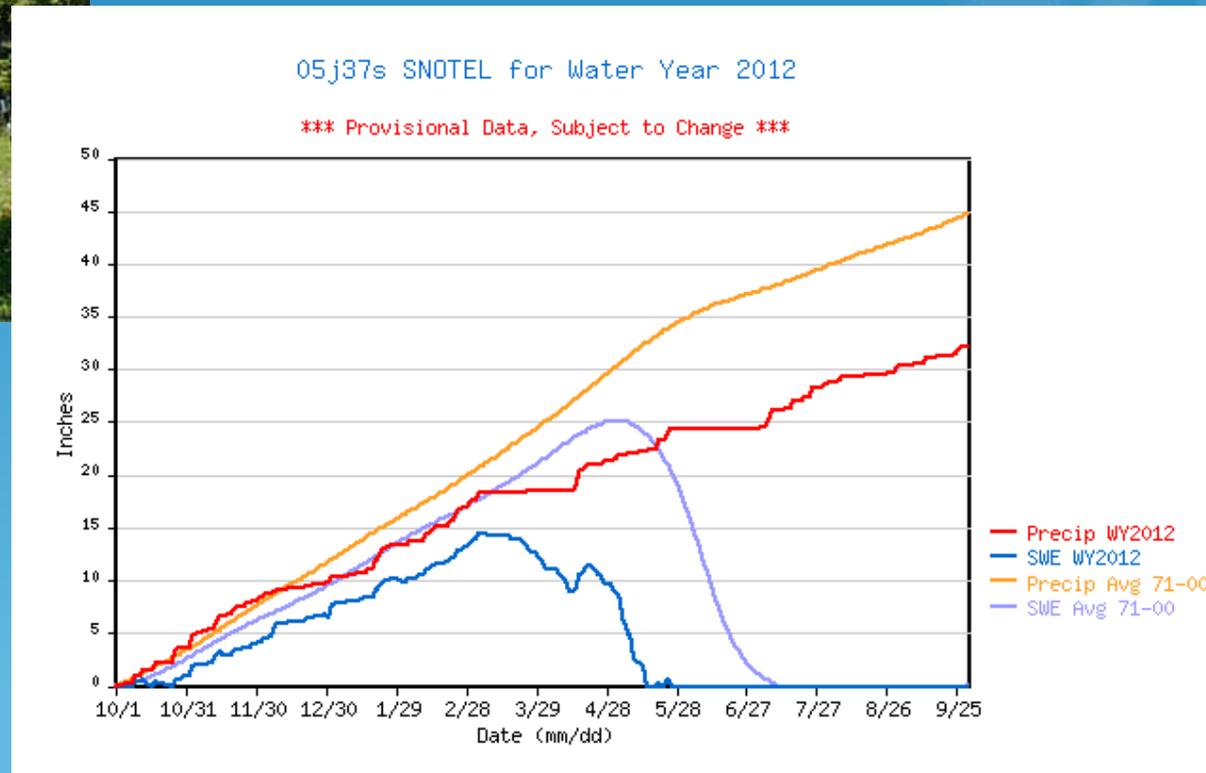
National Climatic Data Center, NOAA

extreme drought	severe drought	moderate drought	mid-range	moderately moist	very moist	extremely moist
-4.00 and below	-3.00 to -3.99	-2.00 to -2.99	-1.99 to +1.99	+2.00 to +2.99	+3.00 to +3.99	+4.00 and above

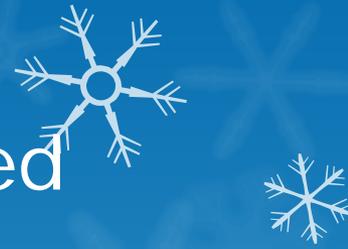
Steady enhancement of SNOTEL network, products and services.



Joe Wright Snotel

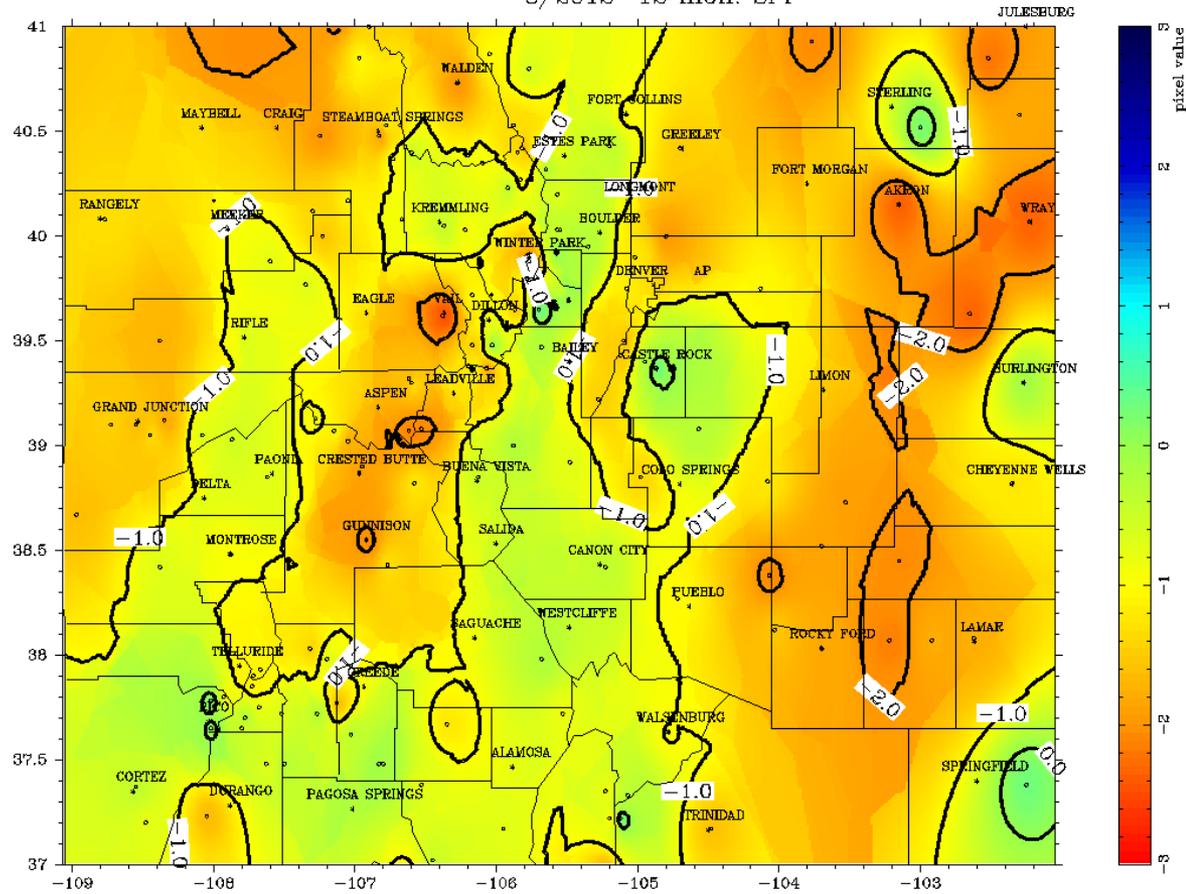


Development, testing and implementation of the Standardized Precipitation Index (SPI)



Colorado

8/2012 12 mon. SPI



100 % < 2.0	63 % < -1.0
100 % < 1.0	5 % < -2.0
99 % < 0.0	0 % < -3.0

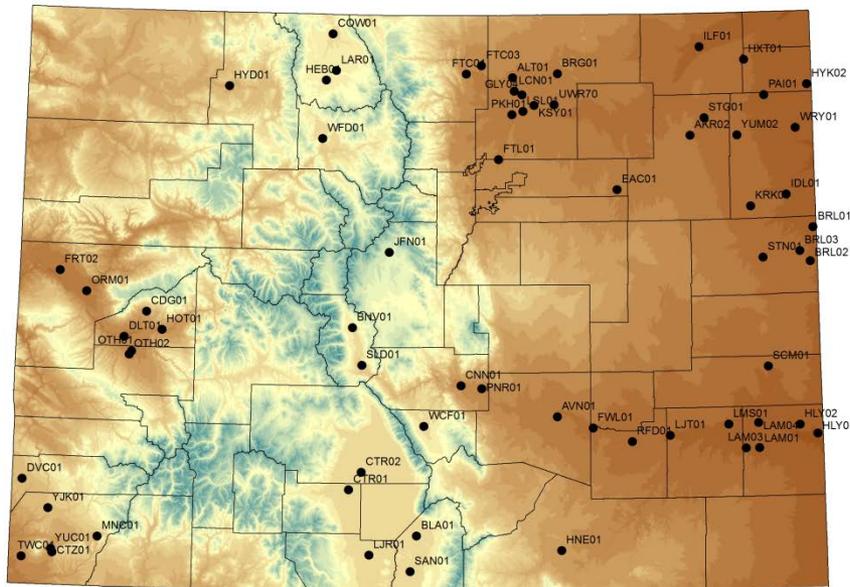
Produced by:
Colorado Climate Center
Fort Collins, CO



Deployment of a real time Ag weather observing network (CoAgMet)

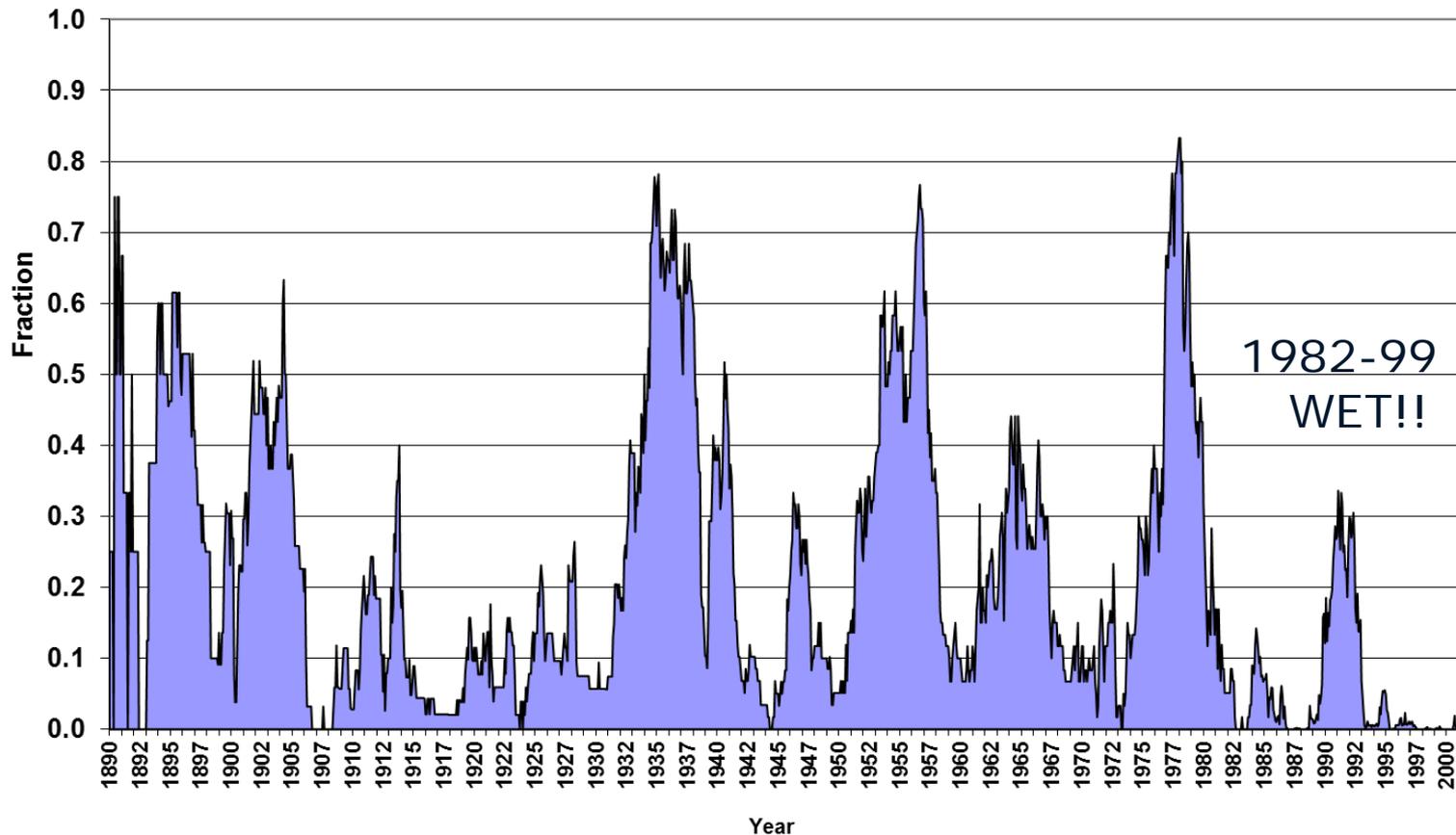


Current CoAgMet Station Locations - July 2012



Most of this took place during the very persistently wet decades of the 1980s and 1990s.

Fraction of Colorado in Drought
Based on 48 month SPI (SPI < -1)
(1890 - 2000)



Despite all of these enhancements and gradual improvements, the drought of 2002 seemed to come as a surprise, despite ardent warnings by Tom McKee in his last year as SC – 1999 – 2000.

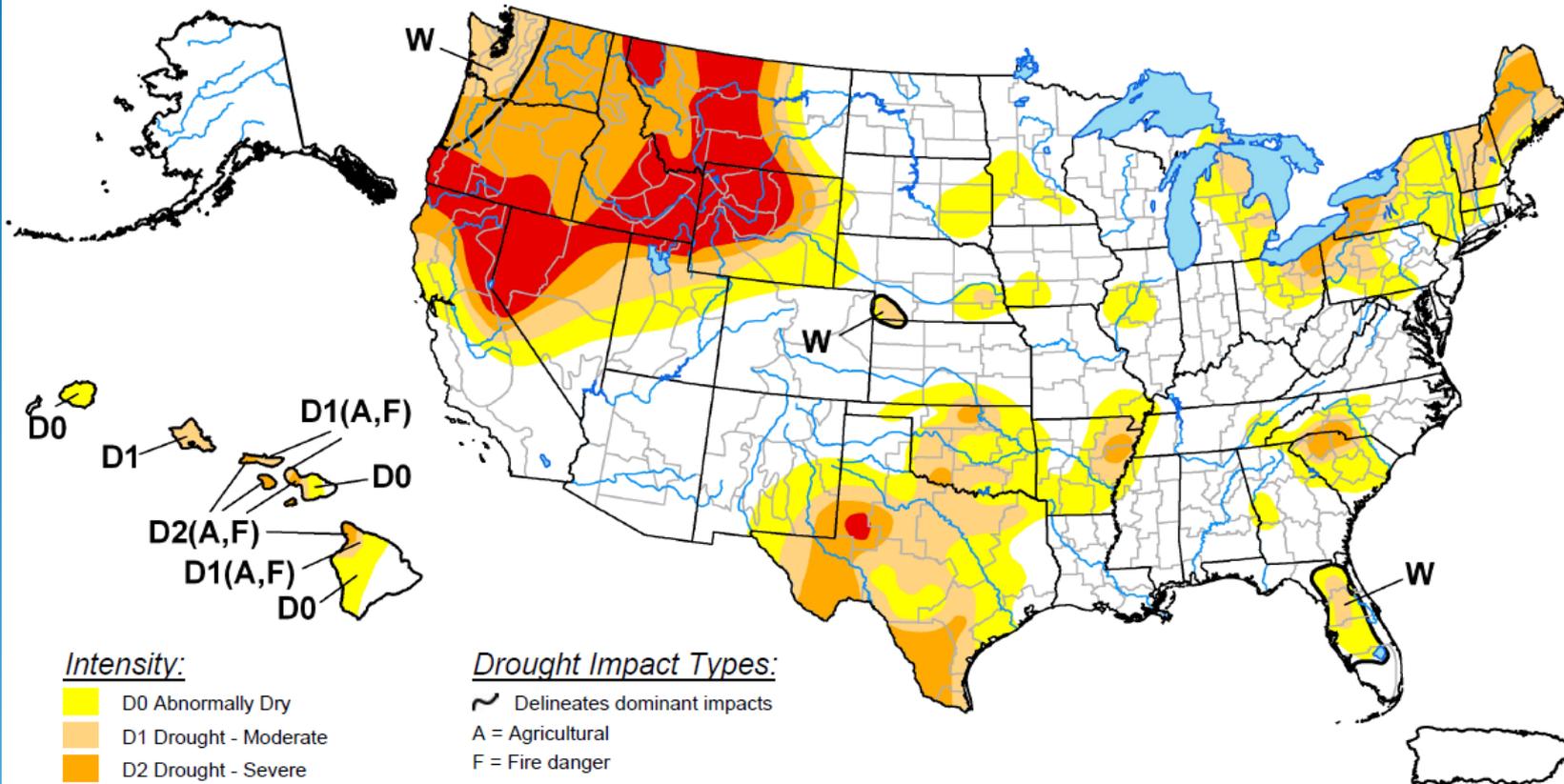
2002 impacts were huge in our wildfire, recreation, tourism, ag and urban sectors.



U.S. Drought Monitor

August 28, 2001

Valid 7 a.m. EST



The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

<http://drought.unl.edu/dm>



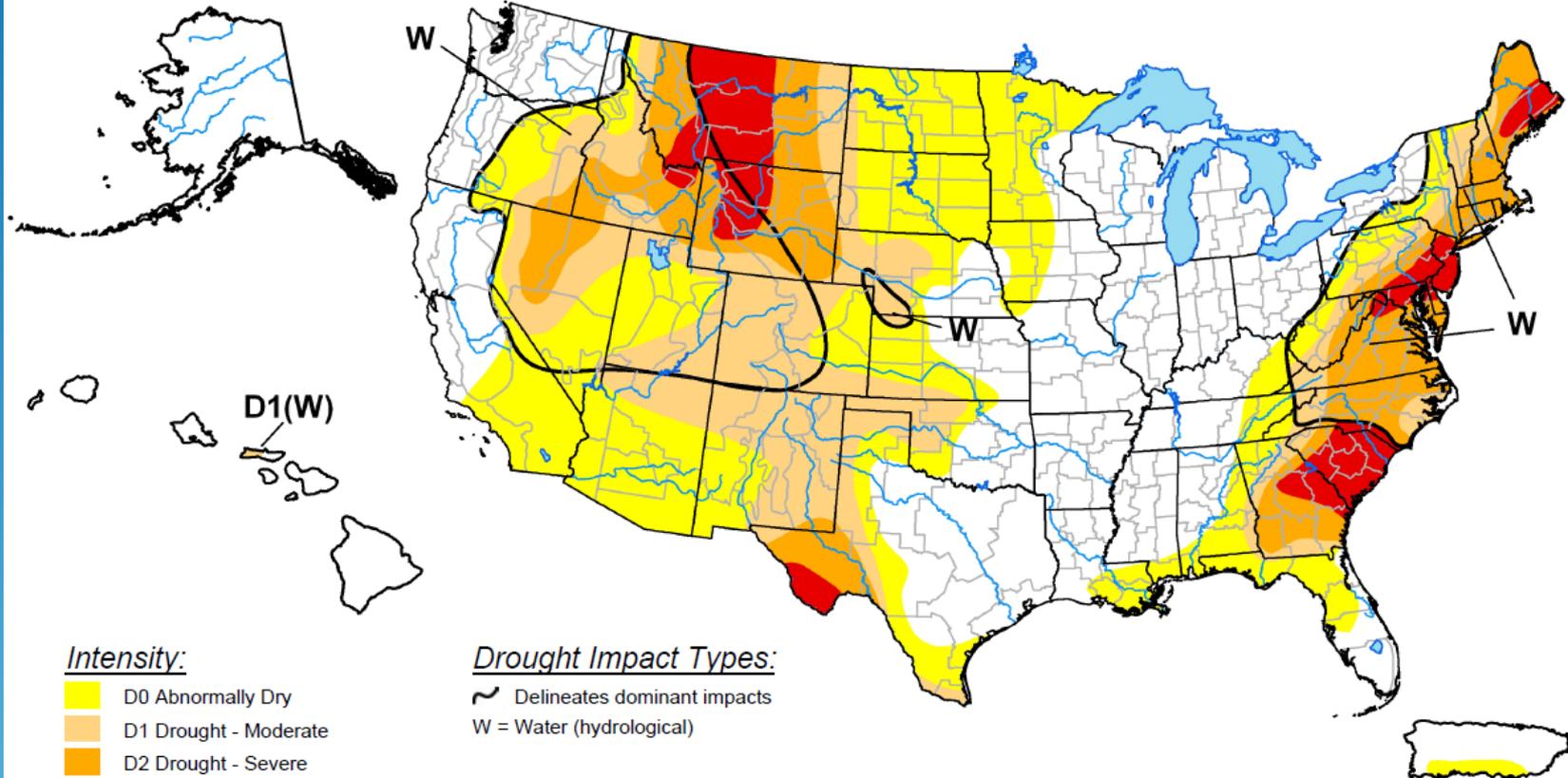
Released Thursday, August 30, 2001

Author: David Miskus, NOAA/CPC/JAWF

U.S. Drought Monitor

February 26, 2002

Valid 7 a.m. EST



Intensity:

-  D0 Abnormally Dry
-  D1 Drought - Moderate
-  D2 Drought - Severe
-  D3 Drought - Extreme
-  D4 Drought - Exceptional

Drought Impact Types:

-  Delineates dominant impacts
- W = Water (hydrological)

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.



Released Thursday, February 28, 2002

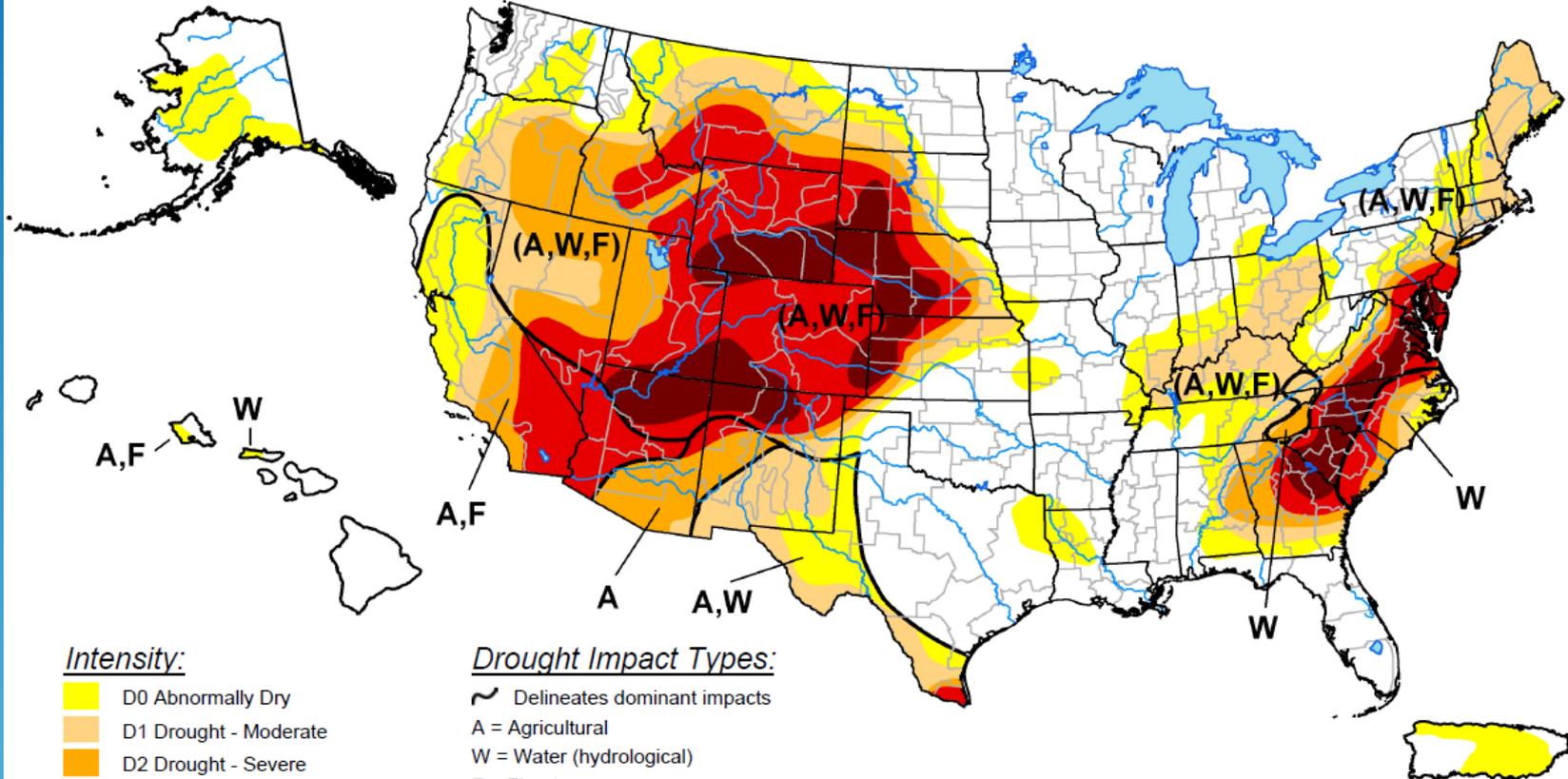
<http://drought.unl.edu/dm>

Author: Michael Hayes, National Drought Mitigation Center

U.S. Drought Monitor

August 27, 2002

Valid 7 a.m. EST



Intensity:

-  D0 Abnormally Dry
-  D1 Drought - Moderate
-  D2 Drought - Severe
-  D3 Drought - Extreme
-  D4 Drought - Exceptional

Drought Impact Types:

-  Delineates dominant impacts
- A = Agricultural
- W = Water (hydrological)
- F = Fire danger

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

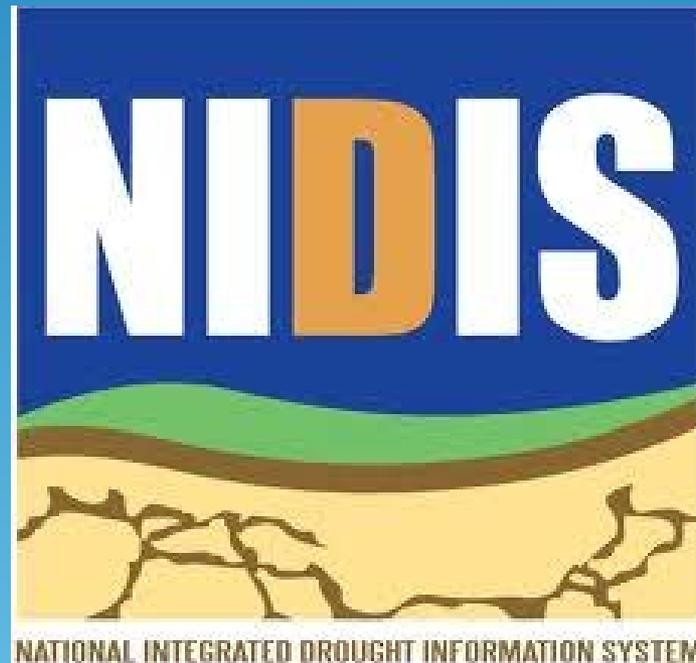
<http://drought.unl.edu/dm>



Released Thursday, August 29, 2002

Author: Richard Heim/Karin Gleason, NCDC

Soon after, NIDIS (National Integrated Drought Information System) was authorized in 2006.



The Upper Colorado Basin was selected as the first NIDIS Pilot project.

Winter 2010

NIDIS - UPPER COLORADO BASIN PILOT PROJECT

Weekly Climate, Water & Drought Assessment

By 2009, our group was selected to lead the monitoring portion and was charged with developing a drought early warning system for the region.



Pilot Focus

- Enhance local, state, and regional drought expertise and monitoring capabilities.
- Identify and address stakeholder needs
- What should a “drought portal” be.
- Give local input to the USDM.
- **Develop and test drought early warning activities.**

Accomplishments and Progress

- 2009 – Stakeholder interviews

(Water users and providers, resource managers and watershed protectors in the UCRB).

- Drought Triggers and Indices
- Monitoring Gaps, Data needs
- Favorite data, products, etc. Find out what they use.



Interview Findings (2009)

- Responses vary by sector and individual user based on “exposure to drought risk”.
- Most but not all stakeholders track available data sources at critical times of year.
- Remote sensing products not trusted for LOCAL drought monitoring and water management.
- Water law, water rights and the prior appropriation doctrine dictates “exposure and potential risk and impacts” for pretty much all surface water users. River “calls” are the ultimate drought triggers.

Interview Findings (2009)

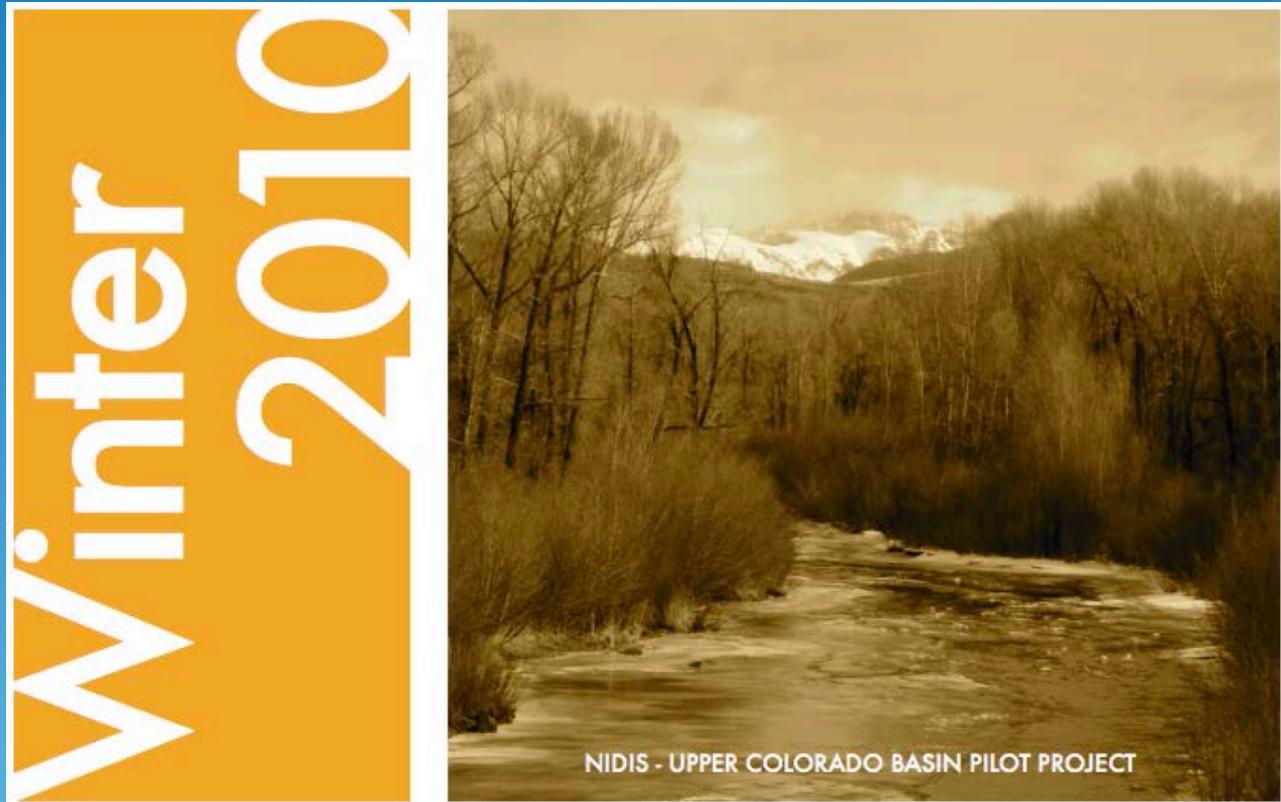
- Reservoir operators: “Our jobs are easiest during drought, but our critical decisions and errors are made during high flows, affecting our capability to deal with future drought”
- Surface Water Interests: “Not worried about a drought until it is a 3-year drought” (Note – this perspective changed in 2012!)
- USDM is popular, but mostly used to assess drought in *OTHER* areas.
- Users want more data all in one place “one stop shopping”
 - More SNOTEL
 - Better gages on unmanaged, representative streams.
- Users crave long range forecasts (out to 2 years) with useful skill – but will take anything delivered with expertise.

Requested Information from Users



- More detailed and timely local monitoring.
- Better forecasts
- Interpretation of complex drought information (i.e. not everyone understands SPI)
- Better elevational depiction of precipitation.
- Historical perspective on streamflow and reservoir data.
- One-stop shopping for all information
- Information on water demand.

This led to Weekly Drought and Water Assessment Webinars starting in 2010



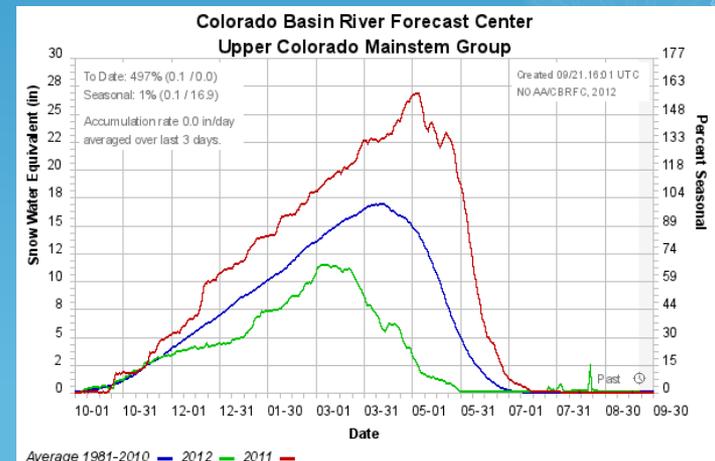
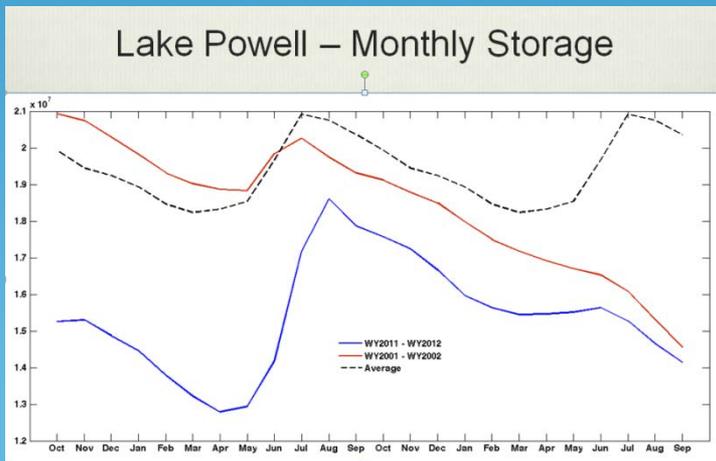
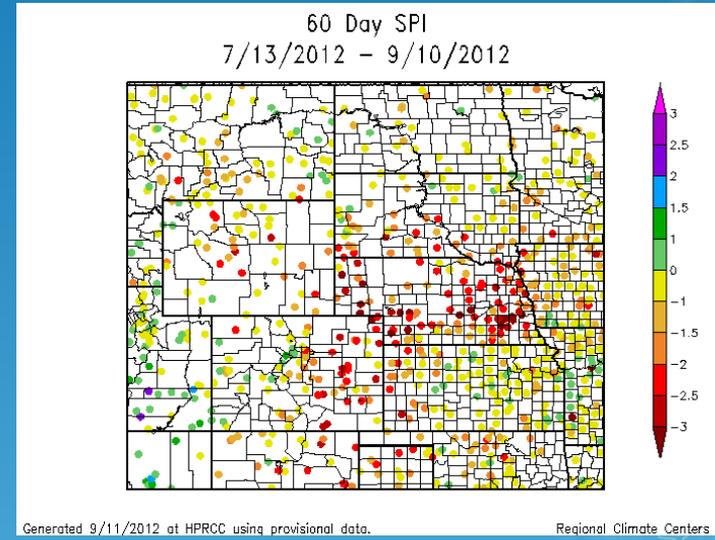
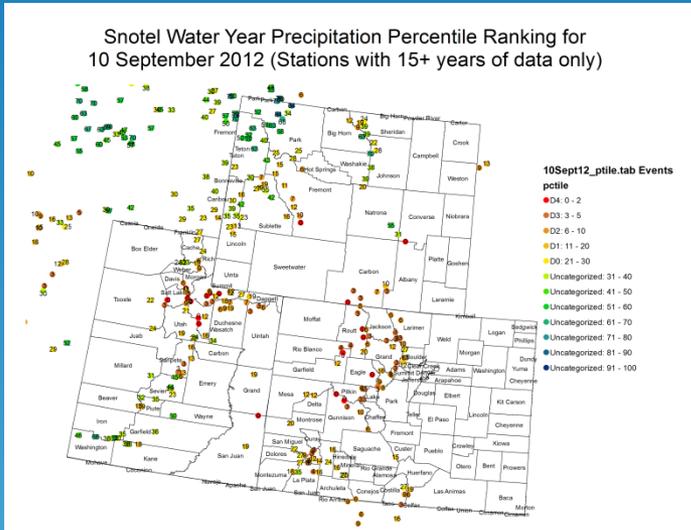
Winter 2010

NIDIS - UPPER COLORADO BASIN PILOT PROJECT

Weekly Climate, Water & Drought Assessment

The graphic features a vertical orange bar on the left with the text 'Winter 2010' in white. To the right is a photograph of a river with a large ice flow, surrounded by bare trees and snow-capped mountains in the background. Below the photo is a blue bar with the text 'NIDIS - UPPER COLORADO BASIN PILOT PROJECT'. At the bottom is a dark green bar with the text 'Weekly Climate, Water & Drought Assessment' in white.

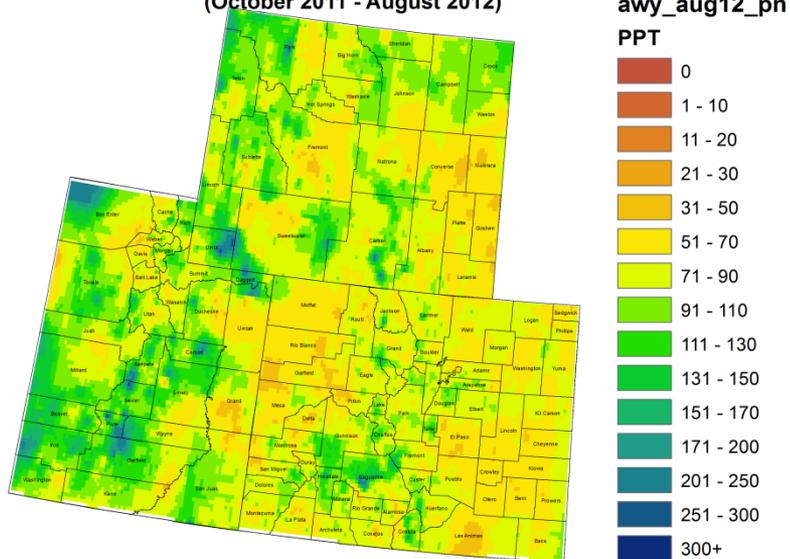
We put current conditions into historical perspective for diverse users with local data



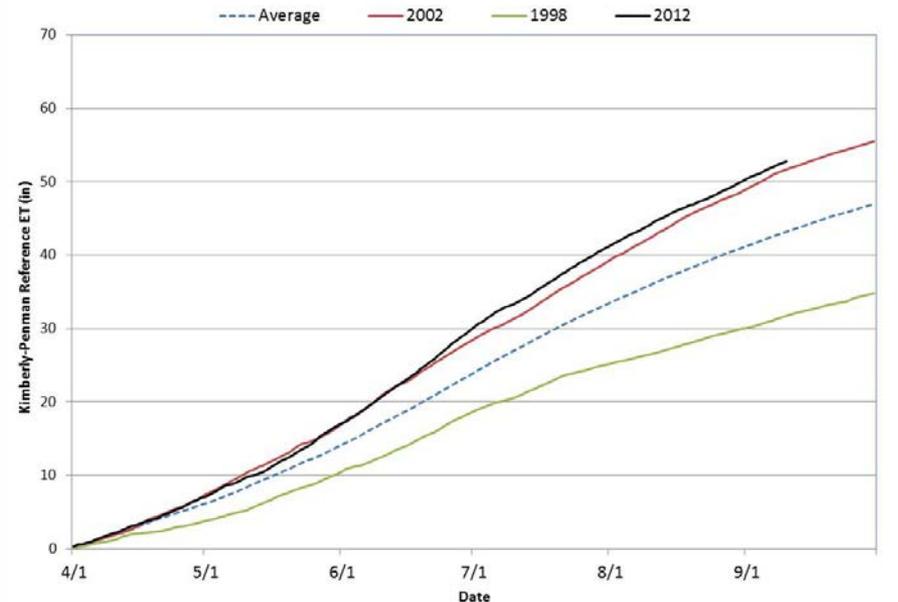
Local Expertise

- Colorado Climate Center and other local agencies provide updates on current conditions.
 - USGS puts streamflow data into context.
 - NWS provides weather forecasts

Colorado, Utah and Wyoming Water Year 2012 Precipitation as Percentage of Normal (October 2011 - August 2012)

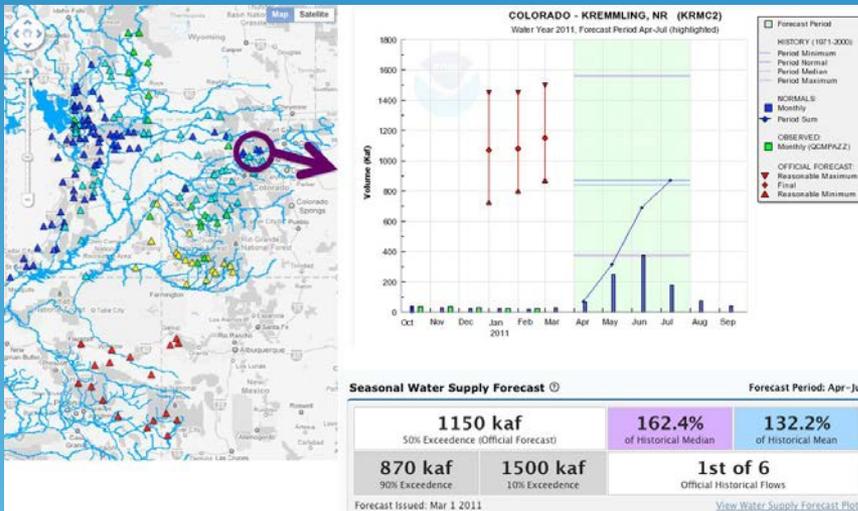


Avondale Kimberly-Penman Reference ET (1993 - 2012)



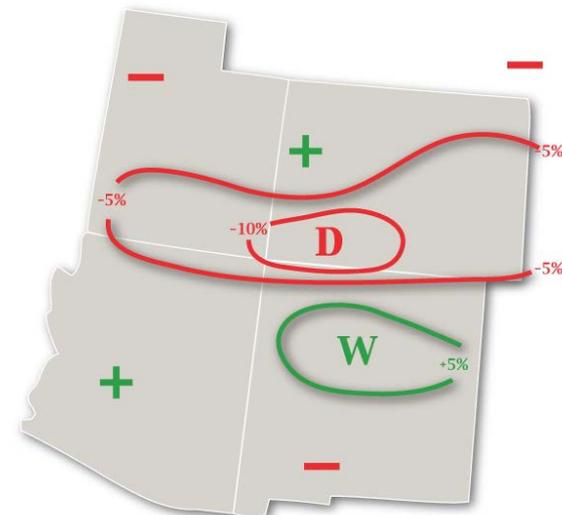
Regional Expertise

- Regional experts provide less frequent, but desirable updates.
 - CBRFC provides water supply and peak flow forecasts.
 - Klaus Wolter provides long range climate outlooks.



Experimental PSD Precipitation Forecast Guidance

APR - JUN 2011 (Issued March 11, 2011)

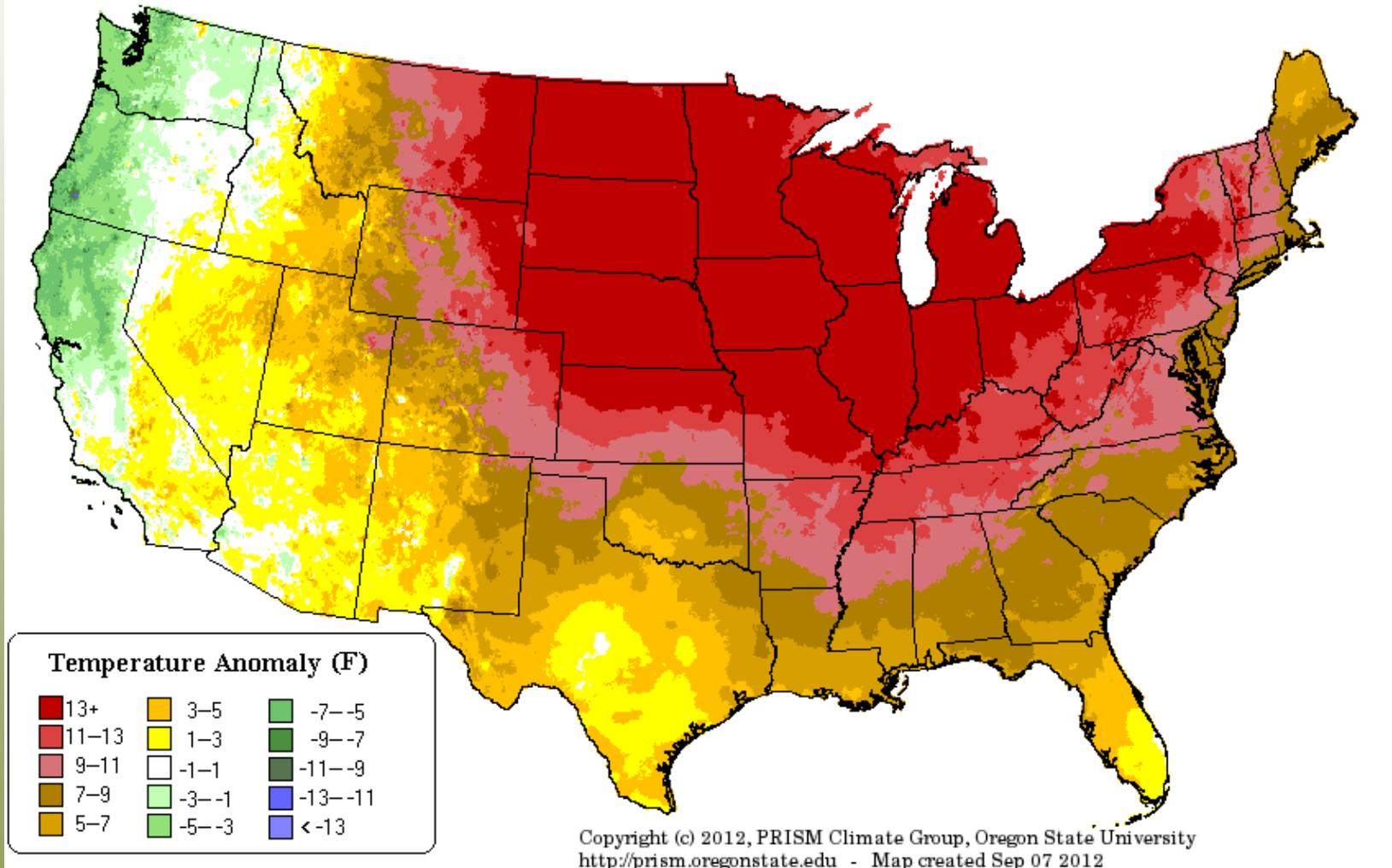


2012 – a “Dry Run” for NIDIS Regional Drought Early Warning System



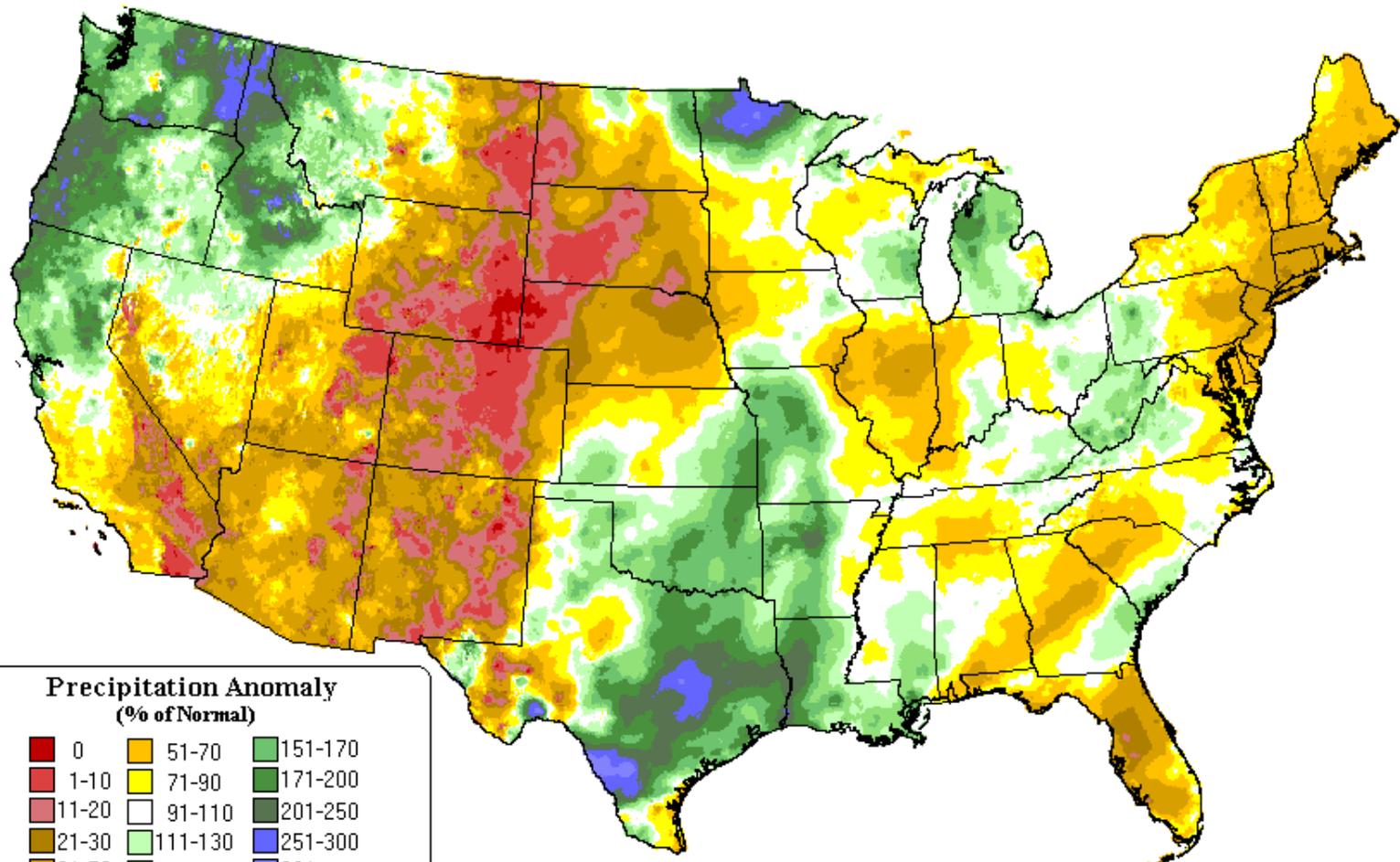
March 2012 – get ready for drought

Maximum Temperature Anomaly: Mar 2012
Final Data



March 2012 Precipitation as percent of Average – DRY!

Precipitation Anomaly: Mar 2012
Final Data



Bare ground showing way too early...

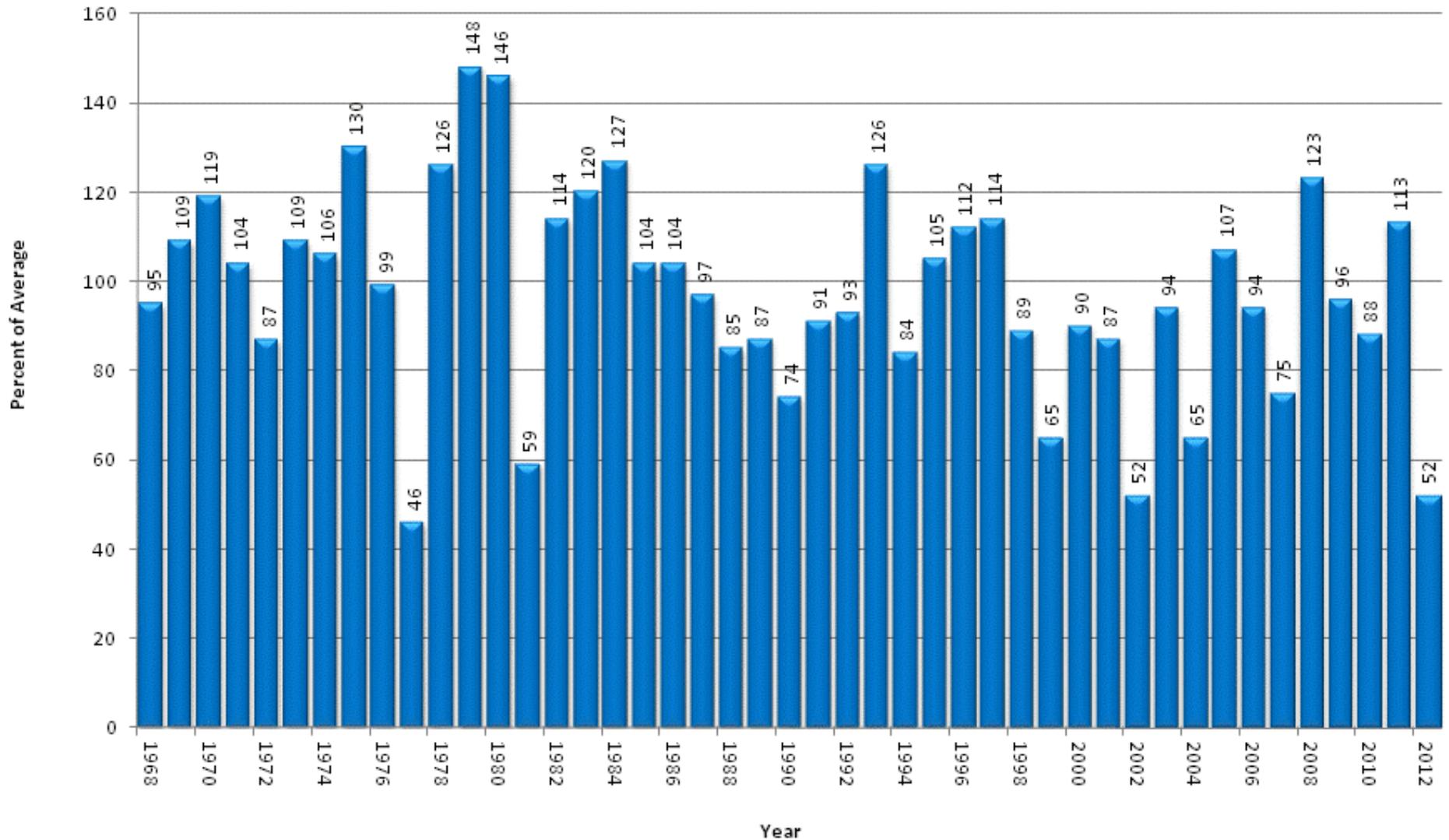
Looking NE from Copper Mountain -- March 24, 2012

-- trouble brewing --



And we never caught up

April 1 Colorado Statewide Snowpack

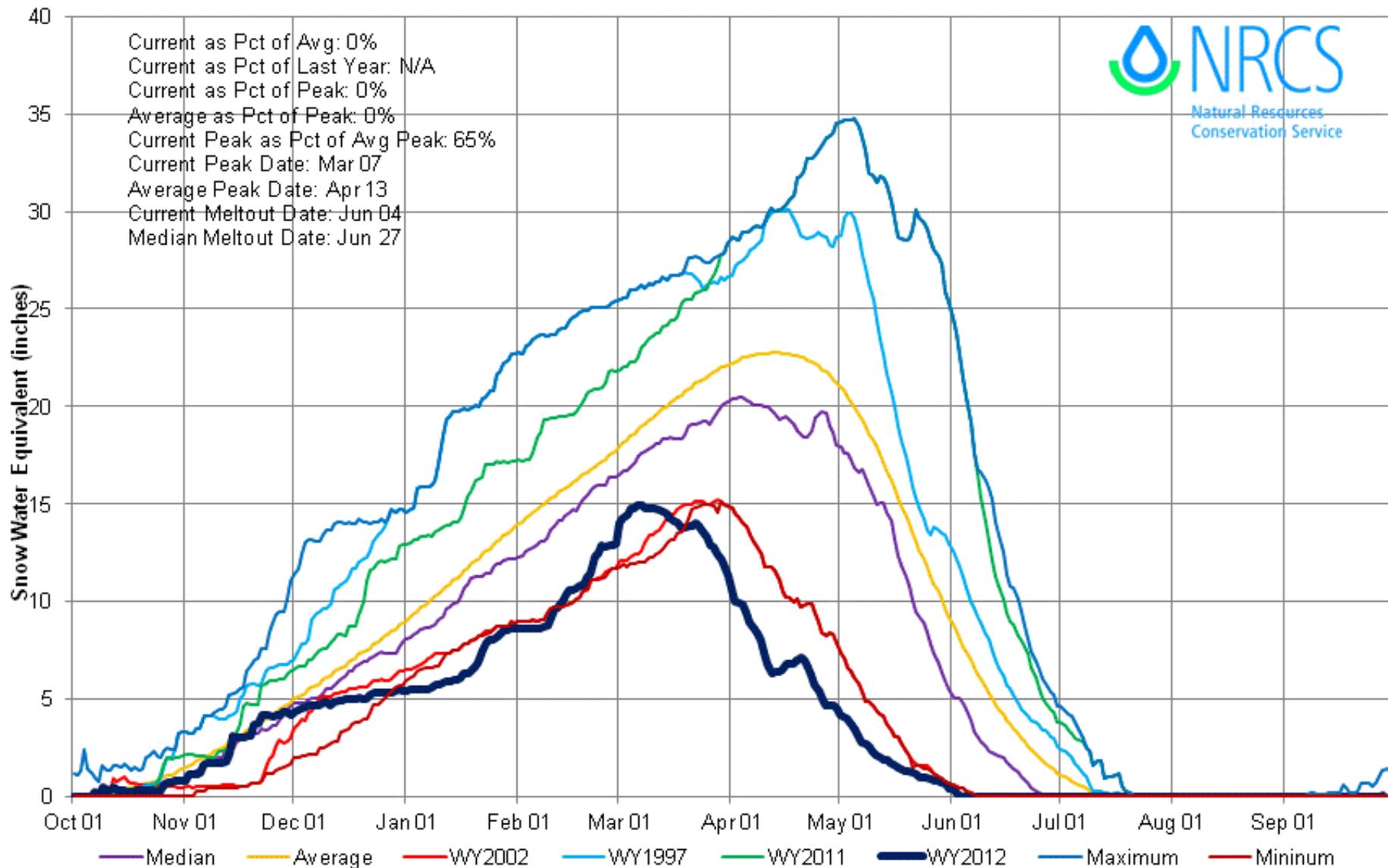


Yampa and White River Basins High/Low Snowpack Summary

Based on Provisional SNOTEL data as of Sep 28, 2012

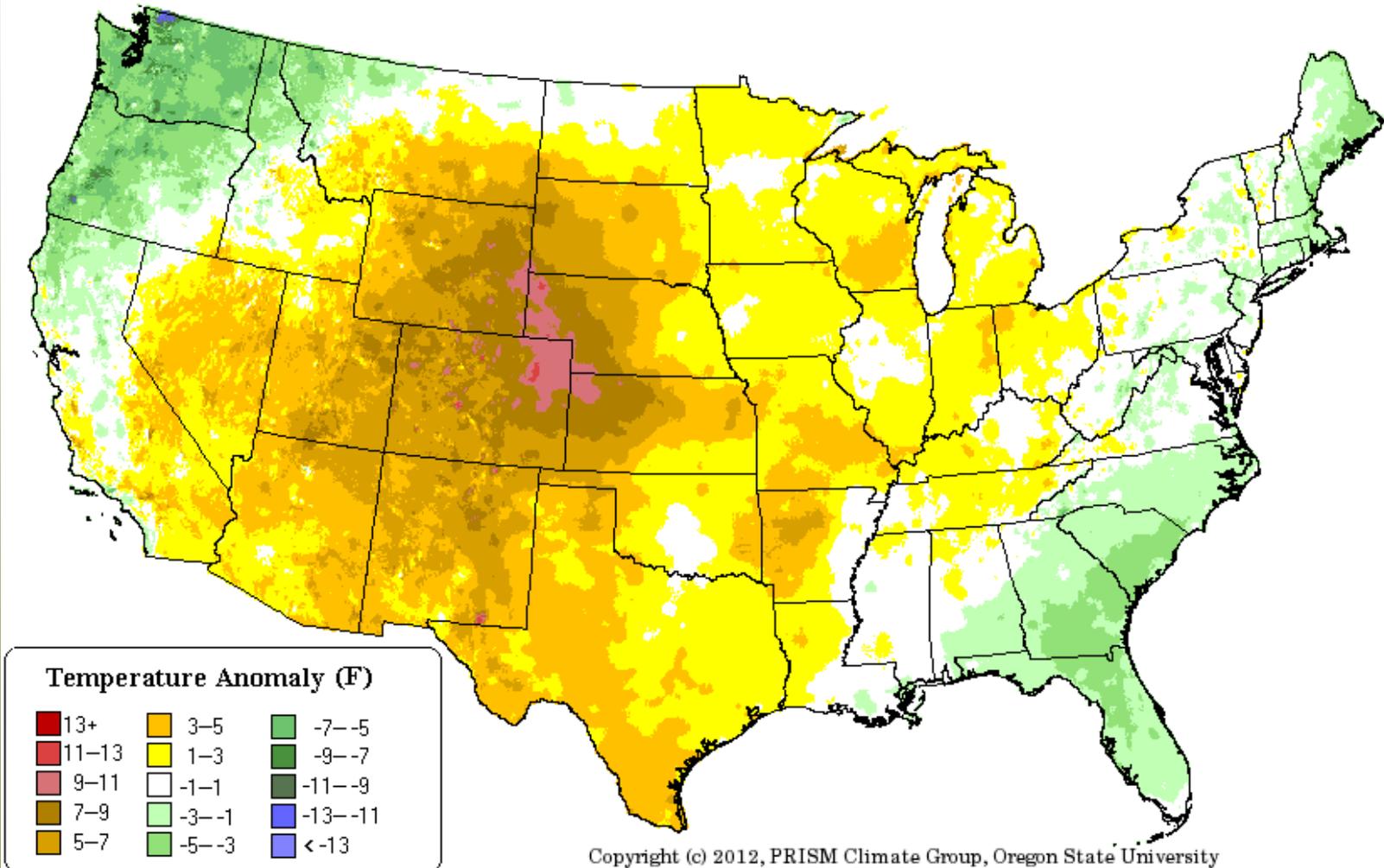


Current as Pct of Avg: 0%
Current as Pct of Last Year: N/A
Current as Pct of Peak: 0%
Average as Pct of Peak: 0%
Current Peak as Pct of Avg Peak: 65%
Current Peak Date: Mar 07
Average Peak Date: Apr 13
Current Meltout Date: Jun 04
Median Meltout Date: Jun 27



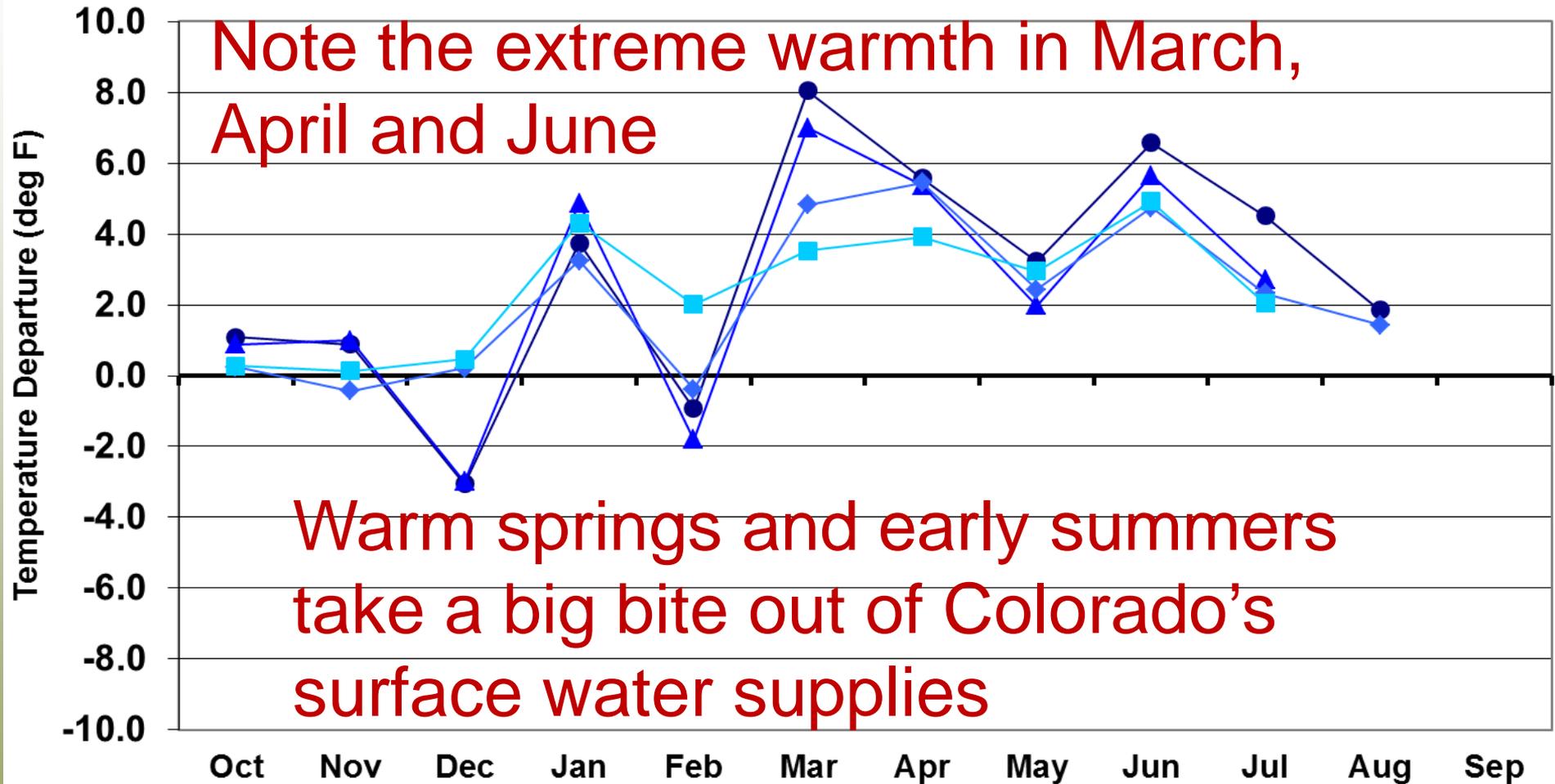
Then came June, and we were immediately engulfed by midsummer heat.

Maximum Temperature Anomaly: Jun 2012
Provisional Data



Water Year Temperature Departure

Water Year 2012



● Eastern Plains

▲ Foothills

◆ Mountains

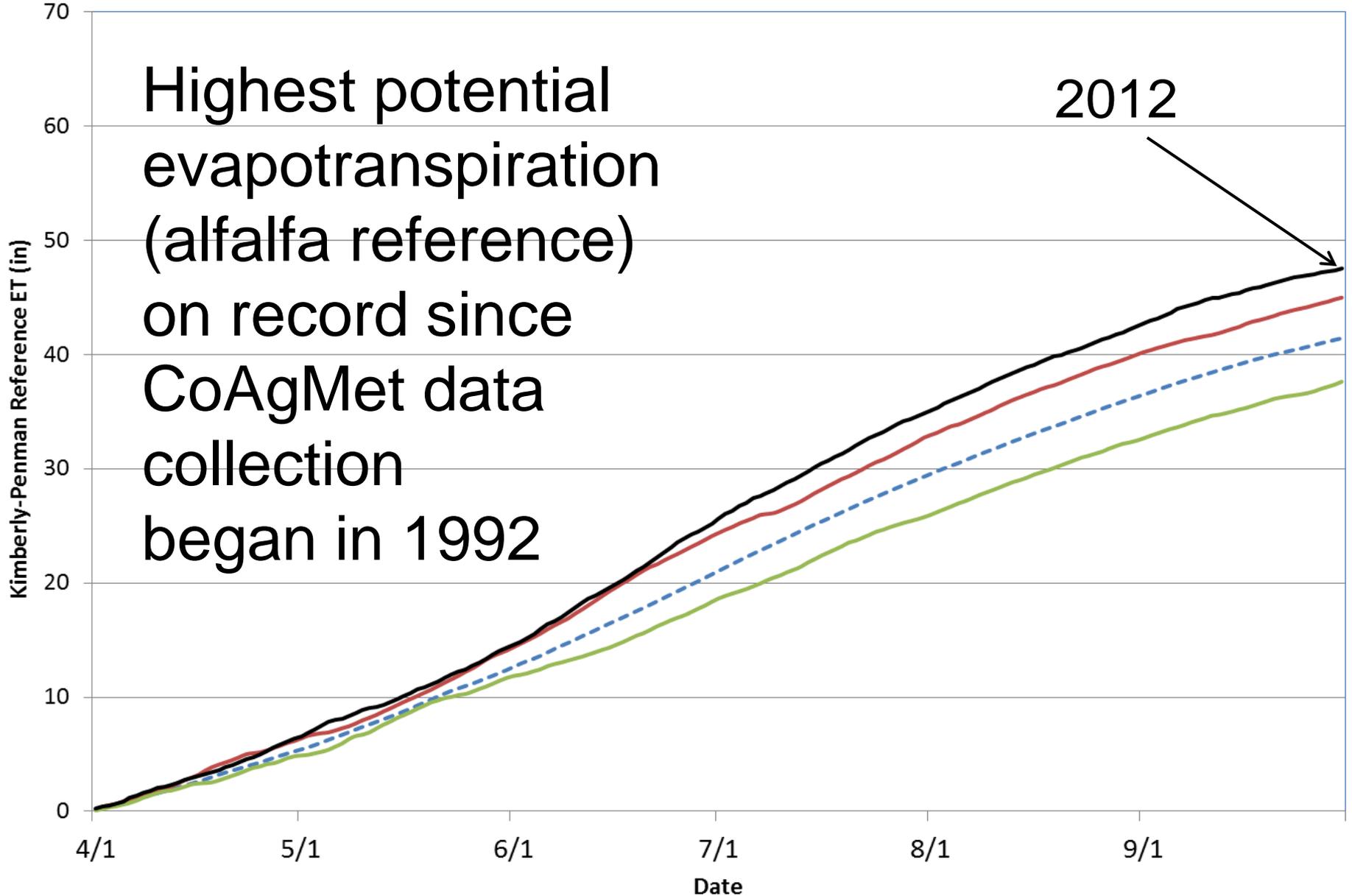
■ Western Valleys

Lucerne Kimberly-Penman Reference ET (1992 - 2012)

--- Average — 2006 — 2009 — 2012

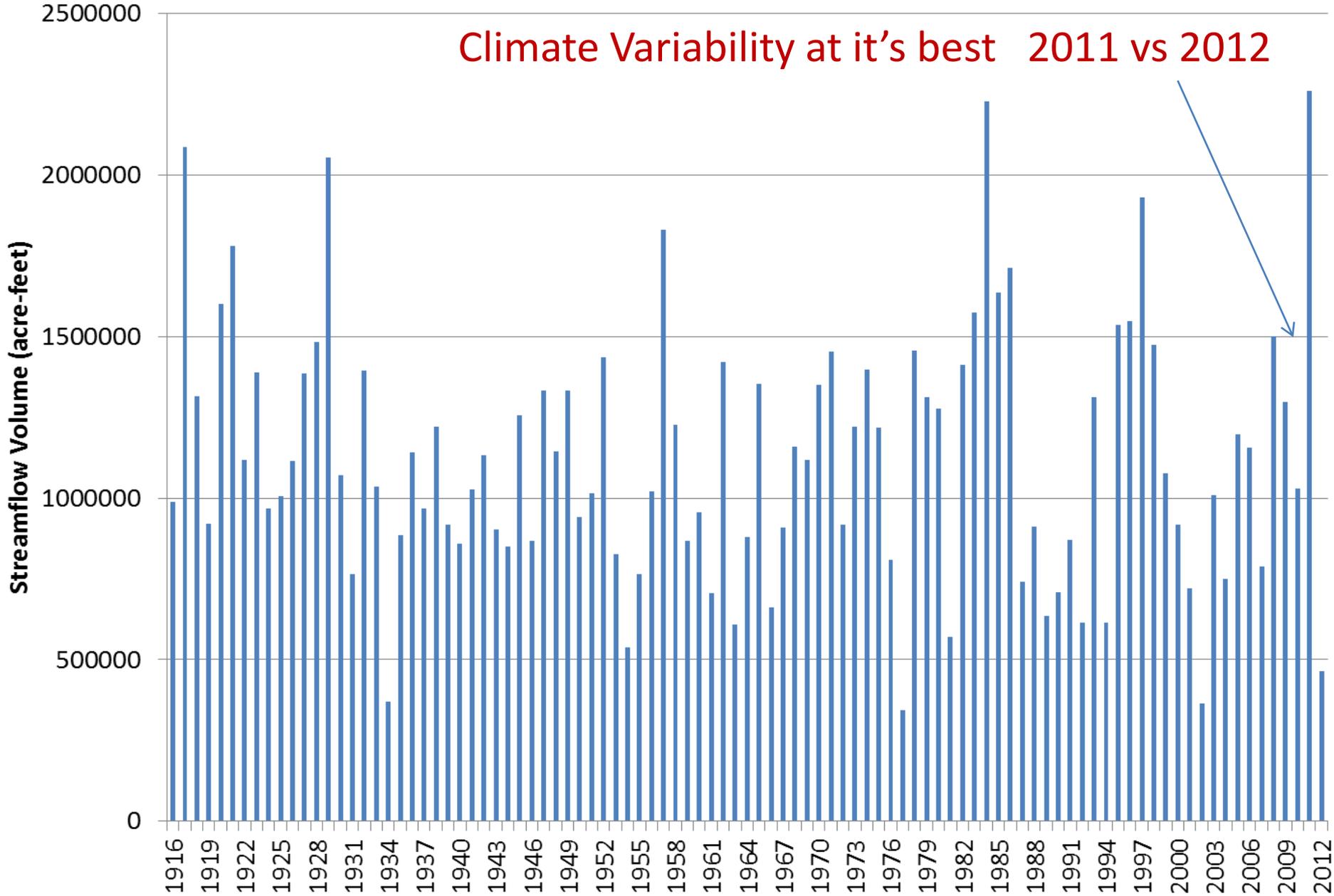
Highest potential
evapotranspiration
(alfalfa reference)
on record since
CoAgMet data
collection
began in 1992

2012



Yampa River Near Maybell, CO Water Year Streamflow

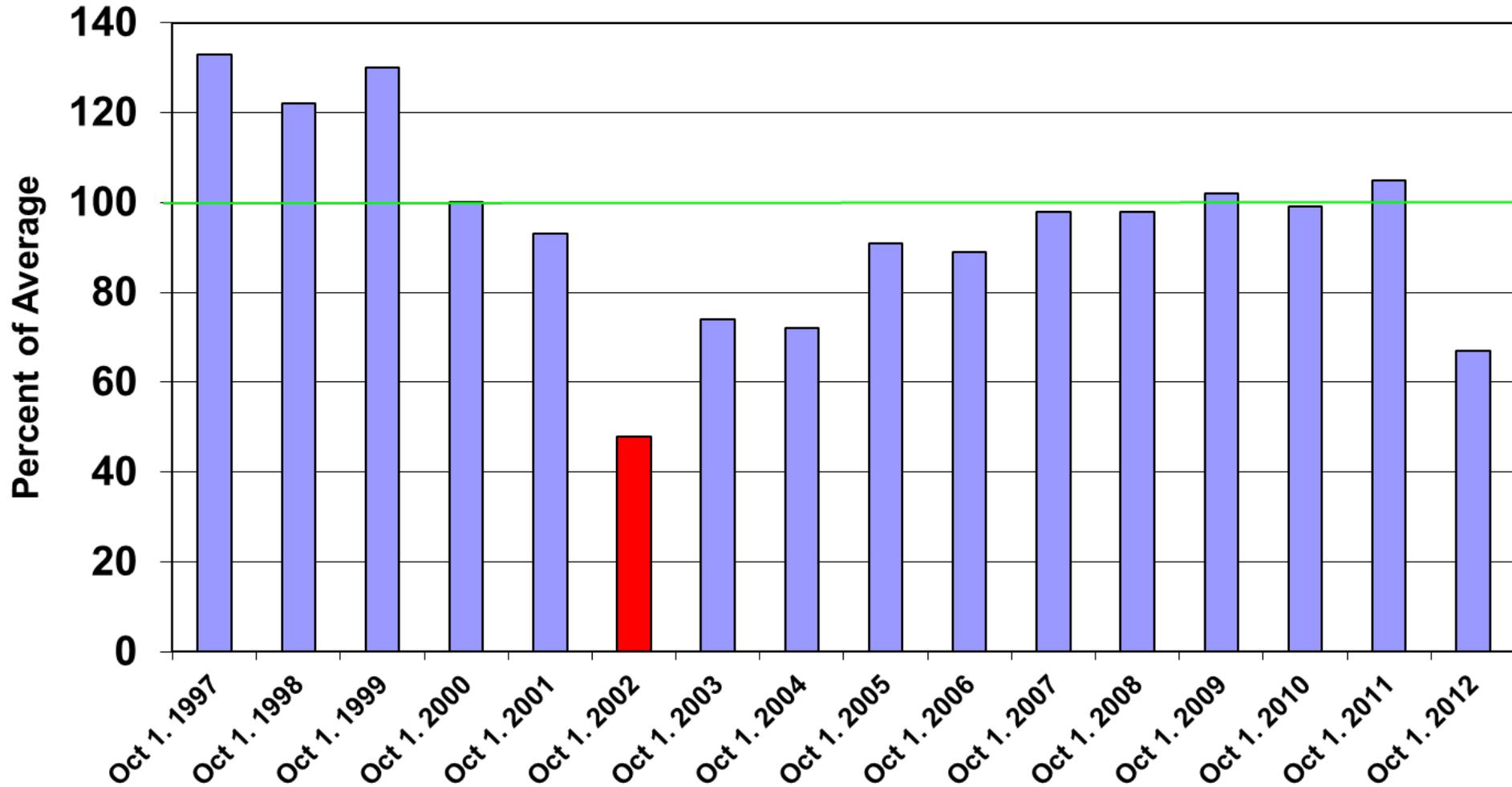
Climate Variability at it's best 2011 vs 2012



Harsh Impacts!



Colorado Statewide Reservoir Levels on October 1st for Years 1997- 2012

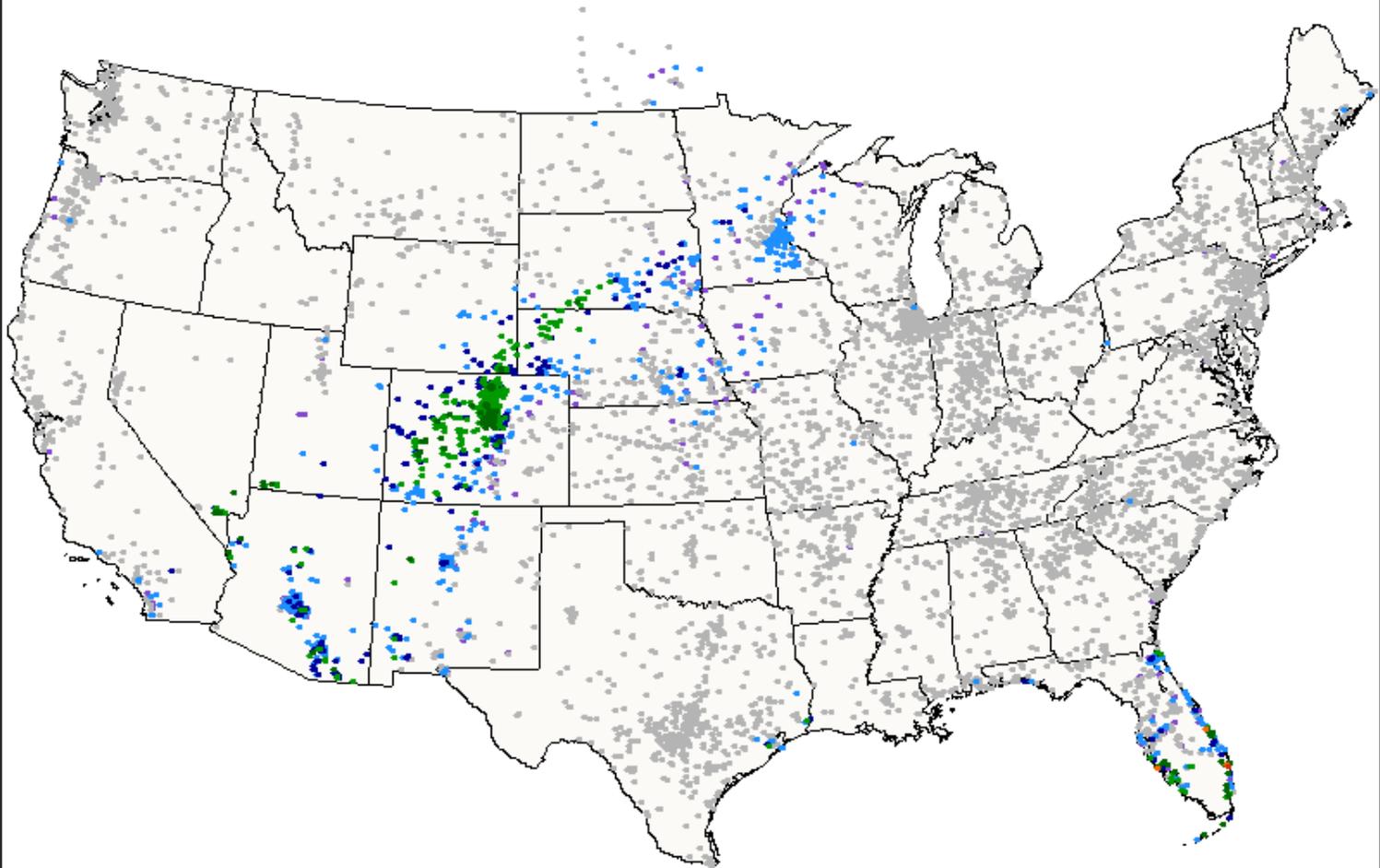


Relentless rain gauge recruiting – engage stakeholders in monitoring

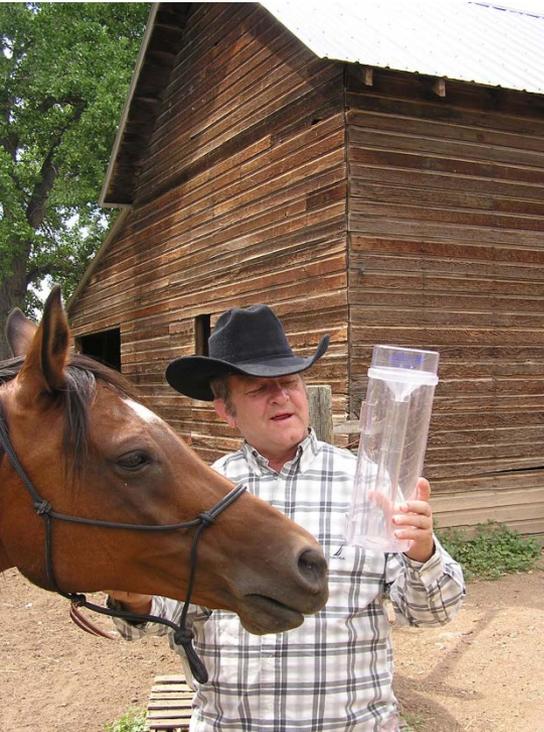
Daily Precipitation (inches x.xx), for the 24 hour period ending ~7:00 am

USA 9/12/2012

0.0 Trace 0.01 - 0.14 0.15 - 0.28 0.29 - 0.70 0.71 - 1.69 1.70 - 2.54 2.55 - 2.83



Grassroots approach -- Please Help Us Monitor Our Climate!



2012 Outreach -- Around 60
Drought Talks and 25 Webinars

“Give me your business card today
and we’ll get you on this
Drought Monitoring
e-mail list”

“You will never again go all week
without getting e-mail 😊”

REFLECTIONS

- Recreation and Tourism vs Ag -- interesting
- Working across state lines presents challenges
- “Western Water Law” – major factor
- Gathering drought impact reports is not a trivial undertaking
- NWS involvement has become substantial
- US Drought Monitor – more used, more trusted!

- The PILOT is now a “Regional Drought Early Warning System”
- It made a difference in 2012



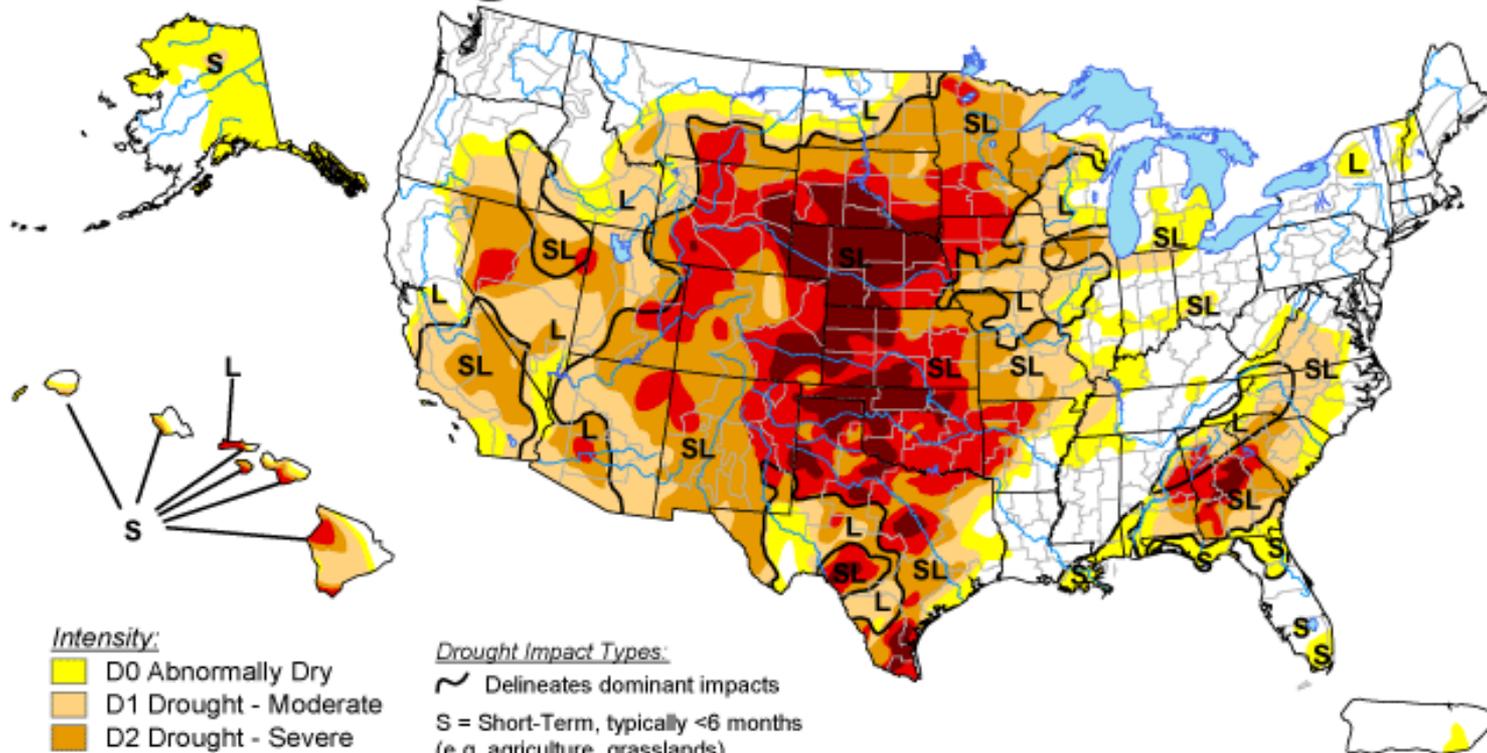
2013 -- a nervous start! We'll be on it!



U.S. Drought Monitor

January 8, 2013

Valid 7 a.m. EST



Intensity:

-  D0 Abnormally Dry
-  D1 Drought - Moderate
-  D2 Drought - Severe
-  D3 Drought - Extreme
-  D4 Drought - Exceptional

Drought Impact Types:

-  Delineates dominant impacts
- S = Short-Term, typically <6 months
(e.g. agriculture, grasslands)
- L = Long-Term, typically >6 months
(e.g. hydrology, ecology)

The Drought Monitor focuses on broad-scale conditions.
Local conditions may vary. See accompanying text summary
for forecast statements.

<http://droughtmonitor.unl.edu/>



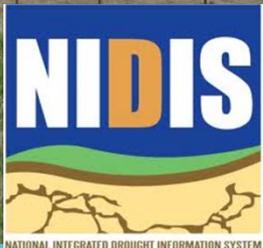
Released Thursday, January 10, 2013

Author: David Simeral, Western Regional Climate Center

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<http://ccc.atmos.colostate.edu>



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